WHAT IS CLAIMED IS:

1   1.   A method for forming a diffusion barrier layer comprising the steps of:

2   a) preparing a silicon substrate;

3   b) contacting the silicon substrate with a composition comprising self-

4 assembled monolayer subunits and a solvent; and,

5   c) removing the solvent

6   thereby forming the diffusion barrier.

1   2.   The method according to claim 1, wherein the self-assembled

2 monolayer subunit is of the following structure:

$$
\begin{array}{c}
Y \\
\backslash \\
Y\!-\!Si\!-\!R^2 \\
/ \\
Y
\end{array}
$$

3
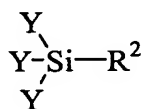
4 wherein Y is an O-alkyl group, and wherein R^2 is an alkyl group, heteroalkyl group, aryl
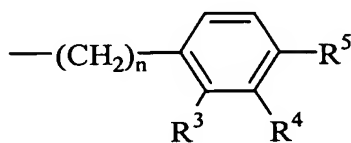
5 group or heteroaryl group.

1   3.   The method according to claim 1 wherein the self-assembled

2 monolayer is of the following subunit wherein Y is a halogen, and and wherein R^2 is an alkyl

3 group, heteroalkyl group, aryl group or heteroaryl group.

$$
\begin{array}{c}
Y \\
\backslash \\
Y\!-\!Si\!-\!R^2 \\
/ \\
Y
\end{array}
$$
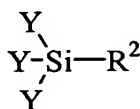
4   4.   The method according to claim 1, wherein the silicon substrate

5 preparation comprises the formation of a silicon oxide surface.

1   5.   The method according to claim 1, wherein the method further

2 comprises the step of heating the silicon substrate and the composition during contact.

1   6.   The method according to claim 2, wherein R^2 is an alkyl group of the

2 following structure:

$$
-(CH_2)_n\!-\!\!\left\langle\!\!\bigcirc\!\!\right\rangle\!-\!R^5
$$
$$
\qquad\qquad R^3 \quad R^4
$$

3

4 wherein R^3, R^4 and R^5 are independently selected from the group consisting of hydrogen,

5 alkyl groups, heteroalkyl groups, halo groups, NH_2, NHR^6, NR^6R^7, OH, OR^6, SH, SR^6, CHO,

6 COOH and CN, and wherein R^6 and R^7 are alkyl groups, and wherein n is an integer ranging

7 from 1 to 5.

1   7.   The method according to claim 2, wherein R^2 is an alkyl group of the
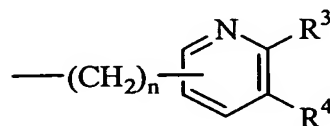
2 following structure:

3

4

$$—(CH_2)_n \overset{N}{\underset{}{\text{pyridine}}} \overset{R^3}{\underset{R^4}{}}$$
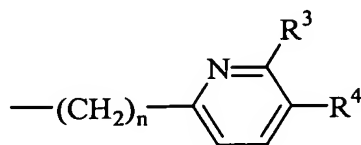
5

6 wherein R^3 and R^4 are independently selected from the group consisting of hydrogen, alkyl

7 groups, heteroalkyl groups, halo groups, NH_2, NHR^6, NR^6R^7, OH, OR^6, SH, SR^6, CHO,

8 COOH and CN, and wherein R^6 and R^7 are alkyl groups, and wherein n is an integer ranging

9 from 1 to 5.

1   8.   The method according to claim 5, wherein Y is OCH_3.

1   9.   The method according to claim 6, wherein Y is OCH_3.

1   10.   The method according to claim 7, wherein R^3, R^4 and R^5 are hydrogen

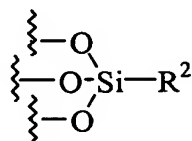2 and n is 2.

1   11.   The method according to claim 8, wherein R^2 is an alkyl group of the

2 following structure:

$$—(CH_2)_n \overset{R^3}{\underset{R^4}{\text{pyridine}}}$$

3

4 and wherein R^3 and R^4 are hydrogen and n is 2.
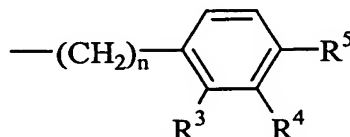
1   12.   A diffusion barrier layer in an integrated circuit, wherein the diffusion

2 barrier comprises a self-assembled monolayer.

1   13.   The diffusion barrier according to claim 11, wherein the self-

2   assembled monolayer comprises subunits, and wherein the subunits are of the following
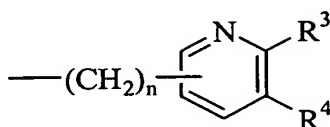
3   structure:

$$\begin{array}{c} \xi-O \\ \xi-O-Si-R^2 \\ \xi-O \end{array}$$

4

5   wherein R^2 is an alkyl group, heteroalkyl group, aryl group or heteroaryl group.

1   14.   The diffusion barrier according to claim 12, wherein R^2 is an alkyl

2   group of the following structure:

$$-(CH_2)_n\!\!\!-\!\!\!\langle\ \rangle\!\!-R^5 \quad R^3 \quad R^4$$

3

4   wherein R^3, R^4 and R^5 are independently selected from the group consisting of hydrogen,

5   alkyl groups, heteroalkyl groups, halo groups, NH_2, NHR^6, NR^6R^7, OH, OR^6, SH, SR^6, CHO,

6   COOH and CN, and wherein R^6 and R^7 are alkyl groups, and wherein n is an integer ranging

7   from 1 to 5.

1   15.   The diffusion barrier according to claim 12, wherein R^2 is an alkyl

2   group of the following structure:

$$-(CH_2)_n\!\!\!-\!\!\!\langle\ \rangle\ \ \substack{N\ R^3 \\ R^4}$$

3

4   wherein R^3 and R^4 are independently selected from the group consisting of hydrogen, alkyl

5   groups, heteroalkyl groups, halo groups, NH_2, NHR^6, NR^6R^7, OH, OR^6, SH, SR^6, CHO,

6   COOH and CN, and wherein R^6 and R^7 are alkyl groups, and wherein n is an integer ranging

7   from 1 to 5.

1   16.   The diffusion barrier according to claim 13, wherein R^3, R^4 and R^5 are
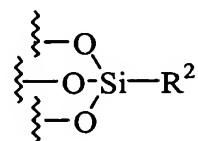
2   hydrogen and n is 2.

1   17.   The diffusion barrier according to claim 14, wherein R^2 is an alkyl
2   group of the following structure:

$$-(CH_2)_n \underset{}{\overset{R^3}{\underset{R^4}{\bigcirc}}}$$

3
4   and wherein R^3 and R^4 are hydrogen and n is 2.
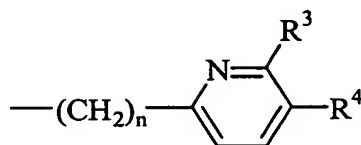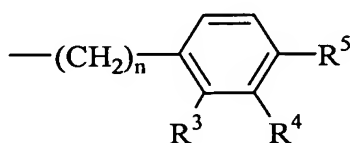
1   18.   An integrated circuit comprising a silicon substrate, a diffusion barrier
2   layer and a metal deposited on the diffusion barrier layer, wherein the diffusion barrier is
3   covalently attached to the silicon substrate, and wherein the diffusion barrier is a self-
4   assembled monolayer.

1   19.   The integrated circuit according to claim 17, wherein the self-
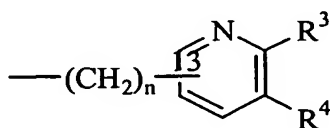2   assembled monolayer comprises subunits of the following structure:

$$\begin{matrix} \xi-O \\ \xi-O-Si-R^2 \\ \xi-O \end{matrix}$$

3
4   wherein R^2 is an alkyl group, heteroalkyl group, aryl group or heteroaryl group.

1   20.   The integrated circuit according to claim 18, wherein R^2 is an alkyl
2   group of the following structure:

$$-(CH_2)_n \underset{R^3 \quad R^4}{\bigcirc} -R^5$$

3
4   wherein R^3, R^4 and R^5 are independently selected from the group consisting of hydrogen,
5   alkyl groups, heteroalkyl groups, halo groups, NH_2, NHR^6, NR^6R^7, OH, OR^6, SH, SR^6, CHO,
6   COOH and CN, and wherein R^6 and R^7 are alkyl groups, and wherein n is an integer ranging
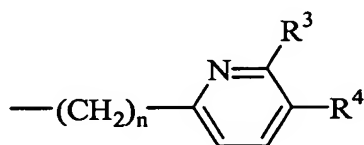7   from 1 to 5.

1   21.   The integrated circuit according to claim 18, wherein R^2 is an alkyl
2   group of the following structure:

$$-(CH_2)_n \underset{}{\overset{N \quad R^3}{\underset{R^4}{\bigcirc}}}$$

3

4 wherein R^3 and R^4 are independently selected from the group consisting of hydrogen, alkyl

5 groups, heteroalkyl groups, halo groups, NH_2, NHR^6, NR^6R^7, OH, OR^6, SH, SR^6, CHO,

6 COOH and CN, and wherein R^6 and R^7 are alkyl groups, and wherein n is an integer ranging

7 from 1 to 5.

1   22.   The integrated circuit according to claim 19, wherein R^3, R^4 and R^5 are

2 hydrogen and n is 2.

1   23.   The integrated circuit according to claim 20, wherein R^2 is an alkyl

2 group of the following structure:

3

$$-(CH_2)_n-\underset{R^4}{\overset{R^3}{\underset{}{\bigcirc}}}$$

4

5 and wherein R^3 and R^4 are hydrogen and n is 2.

6